REMARKS

The Examiner has rejected claims 1, 6 through 8 and 13 through 16 under 35 U.S.C. 102 (b) as being anticipated by the Finger et al. reference. Similarly, the Examiner has rejected claims 2 through 5 and 9 through 12 under 35 U.S.C. 103 (a) as being obvious by the Finger et al. reference. In view of the amendment and the following remarks, the Applicant respectfully requests the Examiner to reconsider the pending rejections.

The Section 102 Rejections

The Examiner has rejected claims 1, 6 through 8 and 13 through 16 under 35 U.S.C. §102 (b) as allegedly being anticipated by the Finger et al. reference. According to the Examiner, the Finger et al. reference teaches measuring voltages of a secondary battery within a predetermined period of the time after termination of charge or discharge to obtain a plurality of measured voltages over time and sequentially calculating the plural measured voltages to determine coefficients of a quadric or more exponential damping function which approximates time characteristics of an open circuit voltage of the secondary battery; calculating a convergent value of the open circuit voltage of the secondary battery based on at least the coefficients determined; and calculating the charged rate based on the convergent value of the open circuit voltage.

Newly amended independent claim 1 now explicitly recites "measuring voltage samples of the open circuit voltage of the secondary battery at a plurality of different time points within a predetermined period of time after termination of charge or discharge to obtain plural measured voltage samples along time axis; using the plural measured voltage samples to determine the coefficients of the time function to thereby determine the time function; [and]

calculating a convergent value of the open circuit voltage of the secondary battery based on the determined time function. . . ."

Furthermore, newly amended independent claim 1 also now explicitly recites "the charged rate" is calculated "based on the convergent value of the open circuit voltage" using "multi-exponential decay function" as below : "wherein (2N+1) coefficients a1 to an, b1 to bn and c are undetermined, Y denotes the open circuit voltage, and X denotes time."

$$Y = a1\exp(-b1\cdot X) + a2\exp(-b2\cdot X) + a3\exp(-b3\cdot X) + a4\exp(-b4\cdot X) + \cdots + an\exp(-bn\cdot X) + c$$

Similarly, newly amended independent claim 8 now explicitly recites "a voltage sensor to measure voltage samples indicative of an open circuit voltage of the secondary battery at a plurality of different time points within a predetermined period of time after termination of charging or discharging."

Furthermore, newly amended independent claim 8 also explicitly recites "a providing means for providing . . . multi-exponential decay function, where N is an integer of at least two is given by [the following equation]

$$Y = a1\exp(-b1\cdot X) + a2\exp(-b2\cdot X) + a3\exp(-b3\cdot X) + a4\exp(-b4\cdot X) + \cdots + an\exp(-bn\cdot X) + c$$

wherein (2N+1) coefficients a1 to an, b1 to bn and c are undetermined, Y denotes the open circuit voltage, and X denotes time; a function determining means for using the measured voltage samples to determine the coefficients of the multi-exponential decay function to thereby determine the multi-exponential decay function; and a charge determining means for calculating the charged rate of the secondary battery using at least the determined multi-exponential decay function, the charge determining means including means for determining a convergent value of the open circuit voltage using the determined multi-exponential decay function, and for calculating the charge rate using the determined convergent value of the open circuit voltage."

Lastly, newly amended independent claim 15 now explicitly recites "[a] power supply system with secondary battery comprising the apparatus calculating charged rate as claimed in claim 8."

The above quoted portions of newly amended independent claims 1 and 8 explicitly require "the plural measured voltage samples" or "the measured voltage samples." They also respectively explicitly limit "a convergent value of the open circuit voltage of the secondary battery based on the determined time function" using "a combination of at least two exponential decay functions" and "a convergent value of the open circuit voltage using the determined multi-exponential decay function." Lastly, newly amended independent claims 1 and 8 both explicitly recite the equation for the multi-exponential decay function as follows:

$$Y = a1\exp(-b1\cdot X) + a2\exp(-b2\cdot X) + a3\exp(-b3\cdot X) + a4\exp(-b4\cdot X) + \cdots + an\exp(-bn\cdot X) + c$$

By the same token, newly amended independent claim 15 also explicitly recites the above patentable features since it incorporates "the apparatus calculating charged rate as claimed in claim 8."

For the following reasons, the Finger et al. reference fails to anticipate the above discussed patentable features of newly amended independent claims 1, 8 and 15. First, the newly amended independent claims require "the plural measured voltage samples" or "the measured voltage samples." In contrast, the Finger et al. reference discloses a single voltage sample of an open circuit voltage of a secondary battery is taken at a particular time point after termination of discharging the secondary battery (e.g. one minute after the termination) and is used to indicate a state of charge (charged rate) of the secondary battery. In Fig. 2 of Finger, one-minute timer (28, 30) generates a sampling pulse when one minute has elapsed from the termination of discharge (quiescence or no load

condition). During the sampling pulse, clock pulses are supplied (34) to a sample-and-hold (40, 36, 42) which samples the open circuit voltage of the battery 10 (provided from the voltage divider 48, 50) at the time point of the sampling pulse and holds the same which is output (44) to indicate a state of charge of the battery on the indicator 46. For an indication of the state of charge (charged rate) of the secondary battery, the Finger et al. reference assumes a fixed relation between the state of charge (charged rate) of the secondary battery and the single voltage sample. Thus, the Finger et al. reference fails to disclose "the plural measured voltage samples" or "the measured voltage samples" of the independent claims.

Secondly, the newly amended independent claims require "a convergent value of the open circuit voltage of the secondary battery based on the determined time function" using "a combination of at least two exponential decay functions" or "a convergent value of the open circuit voltage using the determined multi-exponential decay function." In this regard, again in sharp contrast, the Finger et al. reference discloses in Fig. 1 a predetermined function 11, which provides approximately 37.5 volts at a particular sampling time 17 within one minute after termination of discharge for corresponding to 90 % charge state. For the same sampling condition as illustrated in Fig. 1, approximately 36.8, 36.3, 35.7 and 35.2 volts respectively correspond to 70, 50, 30 and 10 % charge states. Thus, the Finger et al. reference fails to disclose a plurality of "exponential decay functions" of the independent claims.

Lastly, newly amended independent claims 1 and 8 both explicitly recite the equation for the multi-exponential decay function as follows:

$$Y = a1\exp(-b1\cdot X) + a2\exp(-b2\cdot X) + a3\exp(-b3\cdot X) + a4\exp(-b4\cdot X) + \cdots + an\exp(-bn\cdot X) + c$$

Although the Finger et al. reference discloses a function, Open circuit voltage = 35.46 + 0.288 P, where P is a percent of full charge on the battery, the disclosure is limited to the above simple function and clearly lacks any disclosure on the above multi-exponential decay function as explicitly recited in newly amended independent claims 1 and 8.

Accordingly, Finger does not teach obtaining plural voltage samples of the open circuit voltage of the secondary battery or using the plural voltage samples to determine coefficients of a quadric or more exponential damping function (multi-exponential decay function represented by a combination of at least two exponential decay functions). Finger does not teach providing a time function for the open circuit voltage of the secondary battery as a function of time with its coefficients undetermined. Cleary, Finger method does not involve a process for determining the time function for the open circuit by determining its coefficients from a plurality of measured voltage samples.

Based upon the above clearly patentable distinctions, the Applicant respectfully submits to the Examiner that newly amended independent claims 1, 8 and 15 now overcome the pending section 102 rejections. In this regard, dependent claims 6 , 7, 13 14 and 16 ultimately depend from newly amended independent claim 1, 8 or 15 and incorporate the above described patentable features of the independent claims. Therefore, the Applicant respectfully submits to the Examiner that the pending rejections of claims 1, 6 through 8 and 13 through 16 under 35 U.S.C. §102 should be withdrawn.

The Section 103 Rejections

The Examiner has rejected claims 2 through 5 and 9 through 12 under 35 U.S.C. §103(a) as allegedly being obvious by the Finger et al. reference alone. As already described with respect to the section 102 rejections above, among other things, the Finger et al. reference fails to teach multiple voltage samples of the open circuit voltage of the

secondary battery for use with a multi-exponential decay function as represented by a combination of at least two exponential decay functions. As also described above with respect to the section 102 rejections, the Finger et al. reference fails to disclose other patentably distinct features of the current invention as explicitly recited in newly amended independent claims 1 and 8.

Furthermore, the Finger et al. reference also fails to suggest the above discussed patentable features of independent claims 1 and 8. The disclosure of the Finger et al. reference is rather limited since a fixed relation is assumed between the state of charge (charged rate) of the secondary battery and the single voltage sample. This assumption is obviously not utilized in the current invention. As explicitly recited in independent claims 1 and 8, the current invention is more sophisticated in the mathematical treatment of the multiply sampled voltage data. In other words, based upon the disclosure of the Finger et al. reference, it would not have been obvious to one of ordinary skill in the art to provide these patentable features of independent claims 1 and 8.

Dependent claims 2 through 5 and 9 through 12 ultimately depend from newly amended independent claim 1 or 8 and incorporate the above described patentable features of the independent claims. As described above, the Finger et al. reference fails to teach, disclose or suggest these patentable features of independent claims 1 and 8. Therefore, the Applicant respectfully submits to the Examiner that the pending rejections of dependent claims 2 through 5 and 9 through 12 under 35 U.S.C. §103 should be withdrawn.

Support of Amendment to Claims

The amendment to claims is fully supported in the original disclosure and no new matter is introduced thereby. With respect to amendment to claims 5 and 12, the basis for the amendment is indicated in table 1 on page 34 and associated description in the

specification: 10 sec, 60 sec and 600 sec given in the table constitute an instance set of the first, second and third standby times in these claims.

Conclusion

In view of the above amendments and the foregoing remarks, Applicant respectfully submits that all of the pending claims are in condition for allowance and respectfully request a favorable Office Action so indicating.

Respectfully submitted,

/KEN I. YOSHIDA/

Ken I. Yoshida, Esq.
Reg. No. 37,009

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KNOBLE YOSHIDA & DUNLEAVY LLC
Eight Penn Center, Suite 1350
Customer No. 21,302
1628 John F. Kennedy Blvd.
Philadelphia, PA 19103
(215) 599-0600